TITLE: CHAIR

BACKGROUND OF THE INVENTION

The present invention relates to a chair which comprises an operating lever, a cable and a tilting device for locking a seat or a backrest at an optional tilting angle and releasing it.

A conventional chair in which a backrest is locked at an optional stepwise angle usually has a tilting device in which a pin which projects on an operating lever rotatably mounted to a seat or an engagement lever related therewith is engaged with or disengaged from teeth formed on the outer circumferential surface of a sector gear which turns together with the backrest.

However, in the chair, the operating lever is located on the rear side. Especially when an armrest is provided, it is difficult to operate the operating lever since an arm of a person must be turned outward of the armrest.

In a home chair, under a seat, there are provided operating levers for adjusting a tilting angle of the backrest or the seat, height and promoting force. However, it is hard to operate the operating levers while a person sits in the seat. Especially, one has to adjust a tilting angle of the backrest, while the backrest is inclined downward with the person's back. Thus, as the tilting angle becomes larger, the operating lever goes away from the shoulder of the person thereby making the operation harder.

SUMMARY OF THE INVENTION

In view of the foregoing disadvantages, it is an object of the invention to provide a chair in which a tilting angle of a backrest or a seat can be easily adjusted while a person sits in the seat without the positional relationship between the person and the operating lever being significantly changed even if the person is inclined together with the backrest of the chair.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the invention will become more apparent from the following description with respect to embodiments as shown in appended drawings wherein:

Fig. 1 is a front elevational view of a chair according to the present invention;

Fig. 2 is a side elevational view thereof;

Fig. 3 is a central vertical sectional side view of an armrest;

Fig. 4 is a central vertical sectional side view when the armrest is raised to the highest position;

Fig. 5 is a horizontal sectional top plan view taken along the line V-V in Fig. 3;

Fig. 6 is a horizontal sectional top plan view taken along the line VI-VI in Fig. 3;

Fig. 7 is horizontal sectional plan view taken along the line VII-VII in Fig. 3;

Fig. 8 is an exploded perspective view of a height adjusting mechanism;

Fig. 9 is a vertical sectional rear view taken along the line IX-IX in Fig. 8;

Fig. 10 is a top plan view of a support arm;

Fig. 11 is a top plan view of an armrest in which an arm pad is removed;

Fig. 12 is a side elevational view of a height adjusting member of the height adjusting mechanism;

Fig. 13 is an exploded perspective view to show a base and force promoting return means therein;

Fig. 14 is an exploded perspective view to show the base and locking means thereon;

Fig. 15 is a horizontal sectional plan view taken along the line XV-XV in Fig. 2;

Fig. 16 is a vertical sectional side view taken along the line XVI-XVI in Fig. 15;

Fig. 17 is a vertical sectional side view taken along the line XVII-XVII in Fig. 15;

Fig. 18 is a developed view of a cam surface of right and left cylindrical cam in a switching means;

Fig. 19 is a top plan view which shows lock-release condition of locking means;

Fig. 20 is a top plan view which shows locking of the locking means;

Fig. 21 is a vertical sectional front view of a cable exit at the lower end of an arm post;

Fig. 22 is a vertical sectional side view taken along the line XXII-XXII in Fig. 21;

Fig. 23 is a partially cut-out side view which shows a variant of an armrest;

Fig. 24 is a vertical sectional side view when an operating lever is moved upward;

Fig. 25 is a top plan view of a support arm;

Fig. 26 is a top plan view of an operating lever; and

Fig. 27 is a vertical sectional front view taken along the line XXVII-XXVII in Fig. 26.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 is a front elevational view of a chair according to the present invention, and Fig. 2 is a side elevational view of the same. The chair has a leg 3 having five feet 2 radially. A telescopic column 4 which has a gas spring (not shown) stands on the center of the leg 3, and the rear end of a base 5 is fixed to the upper end of the column 4.

The base 4 opens at the bottom and is formed as a hollow box, and the bottom is covered with a detachable cover 6.

In the base 5, there are force promoting return means for returning a backrest 7 and a seat 8 in Fig. 13 and switching means for promoting force in Fig. 15, which will be described later.

In the middle of the base 5, a hexagonal shaft 11 penetrates in a transverse direction so as to turn on its axis.

The ends of the shaft 11 which projects from side walls 5a,5a of the base 5 are fixedly covered with tubular portions 12a,12a of a pair of L-sectioned backrest support rods 12,12 for supporting a backrest 7, such that the backrest 7 and the backrest support rods

12,12 can be inclined downward and rearward around the shaft 11 together with the shaft 11.

The numeral 13 denotes a headrest at the upper end of the backrest 7, and 14 denotes an armrest which stands in the middle of the lower portion of the backrest support rod 12.

The armrest 14 comprises an arm post 15 slightly inclined upward on the backrest support rod 12; an armrest support rod 22 engaged with the rod 12 to move up and down, and an arm pad 16 mounted at the upper end of the rod 12 substantially in a horizontal direction. The arm pad 16 can be adjusted in height and width position by a height adjusting mechanism and a horizontal position adjusting mechanism which will be described later.

As shown in Figs. 3 to 9 for describing the left-side armrest, the arm post 15 is made of an ellipse-sectioned metal pipe, and the lower end of the arm post 15 is engaged with the upper end of an L-shaped tubular connecting rod 17 connected to the outer surface of the backrest support rod 12 so that it may be fixed by a screw 18.

The outer circumferential surface except the lower end is covered with a post cover 19 which can be separated into an inner cover 19a and an outer cover 19b made of synthetic resin. The upper portion of the post cover 19 is gradually wider and the upper end of the rear portion is engaged on the lower surface of the rear end of the arm pad 16.

The height adjusting mechanism for the arm pad 16 is disposed in the arm post 15.

As shown in Fig. 8, the height adjusting mechanism 21 comprises a metal armrest support rod 22 which has a horizontal

armrest support plate 21 at the upper end; a pair of height-adjusting synthetic resin members 23 which surrounds the support rod 22 to enable the rod 22 to slide up and down; and a synthetic support member 24 which is engaged in the armrest support rod 22.

On the front edges of side plates 22a of the armrest support rod 22, outward support portions 25,25 are vertically formed and engagement slits 26 are formed in the support portions 25 and the side plates 22a.

Rectangular engagement openings 27,27 are formed slightly above the upper and lower engagement grooves 26,26 of the side plates 22a, and arc-like guide bores 28 are formed in the middle of a lower portion of the side plates 22a. A rectangular opening 29 is formed in the middle of the armrest support plate 21, and the upper end of the armrest support rod 22 is obliquely engaged and welded in the rectangular opening 29. The rear upper end of the armrest support rod 22 is cut out to make a notch 30 through which a cable (described later) passes.

A vertical groove 31 is formed in each of the height-adjusting member 23, and tilted upper and lower end faces 31a,31b are formed in the groove 31. In the groove 31, a stopper member 32 is provided and has a vertical base 32 which has a plurality of oblique engagement portions 32b on its rear surface to form an annular guide path 31c in which a pin 49 (described later) moves.

In Fig. 12, the lower end of the base 32a is formed like an arcuate surface and disposed slightly before a V-shaped bottom of a lower inclined surface 31b of the groove 31. A guide portion 32c is formed at the upper end of the base 32.

A pair of projections 33 of the upper ends of inner height-adjusting members 23 is engaged in recesses (not shown) of the upper ends of outer height-adjusting members 23. Thereafter, a pair of height-adjusting members 23 is put into the arm post 15, and as shown in Fig. 3, outer flanges 23a at the upper ends of the height-adjusting members 23 are engaged on upper end openings of the arm posts 15. An elastic engagement portion 34 formed at the upper end of the height-adjusting member 23 is elastically engaged in an engagement bore 35 of the upper end of the arm post 15 so that the height-adjusting member 23 may be prevented from coming out of the arm post 15.

When the height-adjusting members 23 are engaged in the arm post 15, ribs 36,36 are contacted to each other to form a bore 37 through which a cable 50 (mentioned later) passes as shown in Figs. 5 to 7.

The armrest support rod 22 is inserted in the height-adjusting member 23 by slidably engaging the support portion 25 of the side plate 22a into a guide groove 38 of the height-adjusting member 23 as shown in Figs. 5 to 7.

As shown in Figs. 8 and 9, the support member 24 is an oval shorter in height and depth than the support rod 22, and has a vertical rib 39a; a plurality of horizontal ribs 39b and a rib 39 as shown in Fig. 6 for connecting the ribs 39a,39b to the middle of the inner surface of the support member 24 integrally molded for reinforcement.

In a lower end space of the support member 24, an elastic support 40 which stands on the lower end is provided to achieve

elastic deformation in a back-and-forth direction at the lower end. The upper end is integrally molded with a tubular axial support 42 which has an axial bore 41.

On the front surface of the support member 24, a vertical concave groove 43 is formed approximately over its height, and on the rear surface, arc-sectional holding portions 44, 44 are provided from the lower end to a portion closer to the upper end. Between the holding portions 44,44, a cable 50 described later is held as shown in Figs. 5 to 7.

When the support member 24 secured to the armrest support rod 22 is disposed in the arm post 15, the cable 50 described later is put in the bore loosely.

In Fig. 8, at the same height as the upper and lower ribs 39b, projections 47 are provided from the front end of the support member 24 to the middle, and elastically deformable engagement claws 48 are provided on the side surfaces of the support member 24.

When the support member 24 is engaged with the armrest support rod 22, the projections 47 and the engagement claws 48 are engaged in the engagement groove 26 and the engagement bore 27 thereby preventing the support member 24 from moving vertically and horizontally.

After the support member 24 is mounted to the armrest support rod 22, a pin 49 held in an axial bore 41 of an axis support portion 42 of an elastic support 40 is projected from the side plates 22a through the guide bore 28 of the side plates 22a of the armrest support rod 22 in Fig. 7.

As shown in Figs. 6 and 12, projecting ends of the pin 49 are

supported by the V-shaped bottom of the lower inclined surface 31b in the groove 31 of the height-adjusting member 23, and the pin 49 faces the base of the lower inclined surface of the lowest engagement portion 32b.

As shown in Figs. 3 to 7, the cable 50 is connected to an operating lever 69 at the upper end, and to an inclining device (described in detail later) of the armrest support rod 12. In the arm post 15, a flexible outer tube 50a of the cable 50 has a downward straight portion in the holding portion 44 at the rear end of the support member 24; a U-shaped portion at the lower end of the support member 24; an upward portion inserted in the bore 46 between the front surface of the support member 24 and the height-adjusting member 23; a U-shaped portion at the upper portion of the support member 24 between the side plates 22a of the armrest support rod 22; and a downward straight portion which passes into the bore 37 at the rear end of the height-adjusting member 23 through the cut-out portion 30 at the upper end of the armrest support rod 22 to loosely form a loop in a vertical direction.

The arm pad 16 comprises a synthetic resin armrest pad 52 screwed on a rectangular armrest base plate 51 made of Al alloy, the pad 52 being slightly larger than the base plate 51. A vertical shaft 54 is welded to the rear end of the armrest support plate 21 at the upper end of the armrest support rod 22. A smaller-diameter shaft 54a of the shaft 54 is engaged in a bore 53 of the armrest base plate 51, so that the rear end of the arm pad 16 is rotatably mounted in a horizontal direction by the armrest support rod 22.

The front portion of the arm pad 16 is supported by a support

arm 56 engaged in a support bore 55 of the armrest support plate 21 rotatably in a horizontal direction as below.

As shown in Figs. 3 and 10, the support arm 56 comprises a circular base 56a which can be placed on the armrest support plate 21; an arm body 56b which extends forward and upward gradually from the base 56a; an auxiliary arm 56d which extends forward and has a vertical short axial portion 56c; and a side plate 56e which is in sliding contact with the lower surface of the front portion of the armrest base plate 51. A shaft 57 is projected in the middle of the lower surface of the base 56a and engaged rotatably in the bore 55 of the armrest support plate 21. Mounting of a screw 28 allows the support arm 56 to turn around the bore 55 laterally. A groove 59 is formed on the side plate 56c, and the upper end of an operating lever 69 described later is supported in the groove 59. A sliding portion 60 is projected on the axial portion 56c of the auxiliary arm 56d.

Behind the base 56a and over the arm body 56b, an insertion bore 61 and an insertion groove 62 for the cable 50 are formed to communicate with each other. Under the front end of the arm body 56b, an insertion opening 63 is formed to have a thread 50b at the end of the cable 50 and the end of a wire 50c which extends from the outer tube 50a.

The front portion of the cable 50 is placed in the insertion bore 61 and the insertion groove 62, and the thread 50b and the wire 50c are placed in the insertion opening 63, so that an engagement axial portion at the upper end of the wire 50c is projected from the arm body 56b. The end of the cable 50 is inserted into a grip 64 in

the groove 62 and the opening 63 and fastened by the thread 50b.

As stated above, the support shaft 57 at the lower end of the support arm 56 is rotatably mounted in the bore 55 of the armrest support plate 21. Thereafter, as shown in Fig. 11, the axial portion 56c is put in an elongate bore 66 of a lobe 65 in the front of the armrest base 51. On a pair of engagement step-like portions 67,67 a mutual distance of which is larger than a diameter of the axial portion 56c, the slider 60 is contacted to slide longitudinally so that the support arm 56 may turn laterally while the arm pad 16 is prevented from moving upward.

The upper end face of the arm body 56b is engaged on the lower surface of an upward lobe 65 to support the front portion of the arm pad 16. After the support arm 56 is mounted, under the arm pad 16, an opening 68 through which a hand can be put is surrounded by the arm body 56b, a post cover 19 and the armrest base 51.

The operating lever 69 for operating the cable 50 is secured at the front end of the support arm 56. The operating lever 69 comprises a lever body 69 having an arcuate recess 70 in which a finger is engaged; and a pair of support portions 69b insertable between the auxiliary arm 56d of the support arm 56 and the side plate 56e. As shown in Figs. 3 and 11, a short shaft 69c which is insertable in the support groove 59 of the support arm 56 is projected at the upper end of the support portion 69b.

On the rear portion of the lever body 69a, there is a slit 71 in which the wire 50c at the end of the cable 50 and engagement shaft 50d are inserted, and there is formed a groove 72 for holding the

engagement axial portion 50d.

To mount the operating lever 69 to the support arm 56, before securing the arm pad 16, the axial portion 50d of the cable 50 is inserted in the groove 72 through the slit 71 and mounted by a corner of the upper end thereof. Thereafter, the axial portions 69c at the upper ends of the support portions 69b are engaged in the support grooves 59 of the support arm 56.

The arm pad 16 is mounted, and as shown in Figs. 3 and 10, the lower surface of the lobe 65 of the armrest base plate 51 contacts or draws closer to the upper end of the axial portion 69c. Thus, the axial portion 69c is prevented from leaving the groove 59, and the operating lever 69 can turn upward around the axial portion 69c, so that the wire 50c of the cable 50 is pulled. Furthermore, the operating lever 69 is always urged downward by tension force that acts on the wire 50c of the cable 50. Downward turning of the operating lever 69 is inhibited by engaging the rear end face thereof with the front end face of the arm body 56b.

The upper portion of the support portions 69b of the operating lever 69 may be rotatably mounted to the auxiliary arm 56d of the support arm 56 with a lateral pin thereby omitting the groove 59 of the support arm 56 and the axial portion 69c of the support portion 69b.

As shown in Figs. 3 and 11, a horizontal position adjusting mechanism 73 is disposed on the rear portion of the armrest base plate 51, and comprises, on the upper end of the support shaft 54 of the armrest support rod 22, a position adjusting plate 75 fixed by a screw not to turn horizontally; an operating button 77 which is

engaged in an elliptical guide bore 76 of the armrest base plate 51 to stop and allow turning of the arm pad 16 by engagement and disengagement with the position adjusting plate 75; and a leaf spring 78 for urging the button 77 downward anytime.

An elongate bore 79 which is an arc around a screw 74 is formed in the rear portion of the position adjusting plate75, and a stopper pin is included in the elongate bore 79, so that the armrest can turn horizontally until the pin 80 contacts the right or left end of the bore 79. A blind bore 81 is formed before the bore 53 of the armrest base plate 51, in which a compression spring 82 and a ball 83 pressed upward thereby are disposed.

Four through bores 84 are formed in the middle of the position adjusting plate 75 and arranged as an arc of a circle around the shaft 54, and the ball 83 is selectively engaged in the bore 84. The blind bore 81, the compression spring 82, the ball 83 and the through-bores 84 may be omitted.

In the front portion of the position adjusting plate 75, an arcuate bore 85 is formed on a circle around the shaft 54. On the inner front surface, four engagement recesses 86 are formed such that the centers of the recess 84, the bore 84 and the shaft 54 are arranged on the straight. On the front and rear ends of the operating button 77, support portions 77a,77b are projected in a longitudinal direction to contact the upper surface of the armrest base plate 51, and a pair of axial portions 87 is projected on the front end of the front support portion 77a.

Both the axial portions 87 are rotatably put between a pair of holding portions 88 projected on the upper surface of the armrest

base plate 51, and the lower end of a pressing portion 89 projected on the lower surface of the armrest pad 52 contacts or draws closer to the upper surface of the front portion of the support portion 88a, so that the operating button 77 can turn vertically around the axial portion 87 in the guide bore 76. Instead of the axial portion 87 held by a pair of holding portions 88, a pair of U-shaped bearing portions may be projected on the armrest base plate 51 so that the axial portion 87 is rotatably engaged in the bearing.

The leaf spring 78 has a "<"-shaped section, and the lower portion thereof is received in a rectangular groove on the operating button 77. The upper portion of the spring 78 is pressed by the lower surface of the armrest pad 52.

An engagement shaft 91 is projected downward in the middle of the rear end of the rear support portion 77b, and can be selectively engaged in any one of the engagement grooves 86. The lower end of the operating button 77 is slightly projected in an opening 68 between the arm pad 16 and the support arm 56 to turn upward. In the middle of the lower surface of the operating button 77, a recess 77c for receiving a finger is formed.

In the above embodiment of the armrest device, the height of the arm pad 16 can be adjusted as below:

As shown schematically in Fig. 12, when the height of the arm pad 16 is placed in a lower-limit position, the right and left ends of the pin 49 inserted in the upper end of the elastic support portion 40 of the support member 24 are received in the V-shaped lowest surface of the tilting surface 31b of the groove 31 of the height adjusting member 23 thereby preventing further lowering.

The whole armrest 14 is elevated, and both the ends of the pin 49 are moved rearward and upward along the lower surface of the first step engagement portion 32b of the stopper member 32, so that the elastic support portion 40 is elastically deformed rearward to return to the original vertical position as shown by a two-dotted line when the pin 49 comes over the end of the engagement portion 32b.

Thus, both the ends of the pin 49 are elastically engaged and received on the upper surface of the first-stage engagement portion 32b, so that the height of the arm pad 16 increases by the distance between the lower end of the groove 31 and the first-stage engagement portion 32b and the pin 49 is held at the position.

From this position, the whole armrest 14 is pulled up, the pin 49 is engaged and received on the upper-stage engagement portion 32b in order, so that the height of the arm pad 16 can be adjusted stepwise by the number of the engagement portion 32b. Fig. 4 illustrates an example in which the arm pad 16 is adjusted to the maximum height.

The cable 50 in the arm post 15 is pulled up as well, but is formed as a loop therein and slidably supported in the insertion bore 37. Therefore, the raised height is covered by shortening the loop length thereby avoiding disadvantages of the rising arm pad 16.

When the armrest 14 is pulled up to the upper-limit position, the pin 49 moves forward beyond the end the guide portion 32c. In this situation, when the armrest 14 is pressed down, the elastic support portion 40 is elastically deformed forward contrary to the above, and the pin 49 moves downward through a guide path 31c between a base portion 32a of the stopper member 32 and the front

surface of the groove 31 to the lower end of the groove 31, so that the arm pad 16 goes down to the lower-limit position at once.

To prevent the arm pad 16 from going down rapidly and to buffer impact when it stops at the lower-limit-position, the guide path 31c between the base portion 32a and the groove 31 may have distance such that the pin 49 slides with suitable frictional force.

Using the height-adjusting mechanism 20 as described in the foregoing embodiment, the height of the arm pad 16 can be adjusted stepwise without separate special operating means simply by operation for elevating the whole armrest 14.

The operating lever 69 of the cable 50 is connected to the support arm 56 and elevating therewith, so that the operating lever 69 can be utilized while a person remains comfortably seated thereby improving operation significantly compared with a chair that has an operating lever at the lower part.

To adjust a position of the arm pad 16 in a right-and-left direction, the operating button 77 is pressed up against the leaf spring 78 to disengage the engagement shaft 91 at the rear end from the groove 86 of the position adjusting plate 75. Then, while the operating button is pressed, the arm pad 16 is turned in a right-and-left direction until the ball 83 is put in any one of the bores 84. When a hand is taken off the operating button 66, the engagement shaft 91 is automatically engaged in any one of the recesses 86 thereby adjusting a position of the arm pad 16 stepwise in a right-and-left position depending on the configuration of the seated person. In this situation, to engage the ball 83 and the bore 84 elastically, the arm pad 16 can be turned stepwise appropriately.

The opening 69 through which a hand is inserted is provided under the arm pad 16 and the operating button 77 is provided above the opening 68. By inserting the hand into the opening 68, the position of the operating button 77 can be conveniently reached while still sitting. The arm pad 16 can be grasped with a thumb over the armrest and the other four fingers inserted through the opening 68 thereby turning the operating button 77 and allowing it to be pressed to improve operational capabilities.

The front portion of the arm pad 16 is supported by the support arm 56 which extends forward in the armrest support rod 22 and the rear portion is also supported thereby improving strength against pressing load.

The support arm 56 turns together with the arm pad 16 and a fulcrum of the front portion is not changed. Thus, even if the arm pad 16 is turned in any of the right and left directions, high load strength can be obtained.

Furthermore, the operating lever 69 turns together with the arm pad 16 and the support arm 56 approximately in the same direction as the arm pad 16 right under the front portion of the arm pad 16. Thus, the lever 69 can be easily turned upward by the fingers while the hollow of a hand is put on the front portion of the arm pad 16.

The lever body 69a of the operating lever 69 and the arm body 56b of the support arm 56 are continuously inclined in an approximately forward position thereby avoiding the cable 50 connected with the operating lever 69 to bend at an acute angle and assuring pushpull wire.

With respect to Figs.13 to 20, tilting means "A" for the backrest 7 and the seat 8 as shown in Fig. 1 will be described.

In Fig. 1, between the tubular portion 12a and the armrest 14, a seat support rod 92 is integrally provided, and the upper end of the seat support rod 92 is connected to the inner surface of a pair of guide rails 93 via a shaft 94. The guide rails 93,93 are connected to each other by lateral rods 95. The outer surface of the guide rail 93 is connected to the upper end of each of a pair of support links 96,96 via a shaft 97.

The lower portions of the right and left support links 96,96 are rotatably mounted by a horizontal shaft 99 outside tubular portions 98,98 of the side walls 5a,5a of the base 5, and compelled in a counterclockwise direction in Fig. 2 by a torsion coil spring 100 in each of the tubular portions 98 in Fig. 15. An operating lever 101 for adjusting force promoting return means 9 is fixed to the end of the shaft 99 outside the support link 96.

On the right and left guide rails 93,93, a pair of movable rails 103,103 is mounted to move longitudinally by holding members 102,102 fixed to the seat 8 in Fig. 2. Longitudinal position adjusting mechanism for the seat 8 does not relate to the present invention and description therefore is omitted.

The backrest support rod 12, the seat support rod 92 integrally connected therewith, the support link 96, force promoting return means 9 (described later) and the switching means 10 for promoting force in the base 5 constitute tilting means "A" for tilting the backrest and the seat. By tilting the backrest 7 and the backrest support rods 12,12 rearward and downward around the

shaft 11, the backrest support rods 2,12 and the seat support rods 92,92 integrally formed therewith are tilted rearward, so that the rear portion of the seat 8 is moved rearward and downward and the front portion of the seat 8 is moved slightly rearward and downward by tilting the support links 96,96 rearward against the force of the torsion coil springs 100,100. In this embodiment, the torsion coil springs 100,100 are auxiliary to the force promoting return means 9 in the base 5.

As shown in Fig. 13, the force promoting return means 9 in the base 5 comprises three force promoting units 104,105,106, each of which comprises a cylindrical core 108 having a hexagonal bore 108 in which the hexagonal shaft 11 does not turn; an outer tube 110 approximately coaxial with the core 108 and having a projection 109 which contacts the base 5 or the switching means 10 not to turn with respect to the base 5; and a cylindrical elastic material 111 made of rubber or soft synthetic resin between the core 108 and the outer tube 111, the core 108 turning with respect to the outer tube 110 to deform the elastic material 111 elastically to apply returning rotational force to the core.

The middle force promoting unit 105 is larger in axial length than the other force promoting units 104,106 to increase applicable force. The elastic material 111 of the left force promoting unit 104 is different from those of the other force promoting units 105,106 so that the elastic material 111 of the left force promoting unit 104 has higher elastic coefficient than those of the other force promoting units 105,106, thereby making only the necessary amount of applicable force. Therefore, in this embodiment, force promotion

gradually becomes larger in order of the left, right and middle force promoting units 104,106,105.

In Fig. 16, the projection 109 of the outer tube 110 of the central force promoting unit 105 is always engaged with a stopper portion 112 which suspends from the upper wall 5b of the base 5.

Between the outer force promoting units 104,106 and the side walls 5a,5a of the base 5, a pair of discs 115,115 each of which has a hexagonal bore 113 and a downward projection 114 at the lower portion is disposed so that the hexagonal bore 113 may not turn with the shaft 11. On the upper portion of the right disc 115, there is formed a sector gear 118 which projects through an elongate bore 116 of the upper wall 5b of the base 5 and has teeth 117.

When the backrest 7 stops in the maximum stand-up position or initial position, the sector gear 118 provides functions for force promotion or initial returning force of the central force promoting unit 105 to the backrest 7 and for locking the backrest 7 at optional rearward-tilted position.

Specifically, while the sector gear 118 is turned with the shaft 11 by a predetermined initial twisting angle in a counterclockwise direction in Fig. 16 from where the projection 109 of the outer tube 110 of the central force promoting unit 105 is engaged with the stopper portion 112, the front edge of the sector gear 118 is engaged with the rear end of the a stopper plate 119, which is fixed on the upper wall 5b of the base 5 by a screw 120. While initial twisting force of the central force promoting unit 105 is applied to the shaft 11, the shaft 11 can be held not to turn in a counterclockwise direction in Fig. 16.

Furthermore, in this situation, initial twisting force by the central force promoting unit 105 can be applied to the backrest 7 in the initial position by fixing the tubular portions 12a,12a of the backrest support rods 12,12 as initially positioned to both ends of the shaft 11. The function for locking the backrest 7 of the sector gear 118 in an optional downward-tilting position will be described later.

The downward projections 114,114 of the right and left discs 115,115 are engaged with the outward-projecting portion of an engagement plate 123 fixed to a seating portion 121 of the outer tube 110 of the outer force promoting units 104,106 by screws 122,122. The discs 115,115 and the engagement plate 123 are for applying to the outer force promoting units 104,106 an initial twisting force similar to what is applied to the central force promoting unit 105.

That is to say, while the outer tube 110 is turned with respect to the shaft 11 in a counter clockwise direction in Fig. 17 by the same angle as the initial twisting angle for the central force promoting unit 105 in the outer force promoting units 104,106, the engagement plate 123 is fixed to the seating portion 121 of the outer tube 110 by engaging the projection 114 of the disc 115 with the outer portion thereby applying to the outer force promoting units 104,106 an initial twisting force similar to that applied to the central force promoting unit 105.

As mentioned above, in all the force promoting units 104,105,106, by twisting the outer tubes 110 with respect to the shaft 11 by the same initial twisting angle, when the backrest 7 stops

at the initial position, the projections 109 of the outer tubes 110 of all the force promoting units 104,105,106 are arranged at the same position. Therefore, while the projection 109 of the outer tube 110 of the central force promoting unit 105 contacts the stopper portion 112, the projections 109 of the outer tubes 110 of the other force promoting units 104,106 is positioned above the central projection 109 thereby preventing any likelihood of erroneous operation such as inhibiting right-and-left movement of an operating member in the switching means (described later) and achieving suitable operation of the switching means 10.

As shown in Fig. 15, the switching means 10 comprises an operating shaft 99 rotated by the operating lever 101; a pair of operating members 125,125 which is movable between an operative position in which the stopper portion 124 of the operating member 125 is engaged with the projection 109 of the outer tube 110 of the outer force promoting unit 104,106 and an inoperative position in which the stopper portion 124 is disengaged therefrom; a pair of cylindrical cams 126,127 fixed to the shaft 99 to move the operating members 125,125 inwards independently with rotation of the shaft 99; a compression spring 128 around the shaft 99 between the right and left operating members 125,125 to allow the operating members to move away from each other; and a guide bar 129 between the side walls 5a and 5a of the base 5 to hold the stopper portions 124 of the operating members 125,125 with the upper wall 5b of the base 5 to prevent the operating members 125 from rotation and to guide right-and-left movement of each of the operating members 125.

Cam surfaces 126a,127a of the right-and-left cylindrical cams

126,127 are determined in shape as shown in a development of Fig. 18. When the operating lever 101 is kept at a predetermined 0° position, the right-and-left operating members 125,125 are both in inoperative positions. When the operating lever 101 is turned to the position of 90° position from the situation, only the left operating member 125 is pressed rightward against exerting force on the compression spring 126 and kept in an operating position, while the right operating member 125 is still kept in an inoperative position. When the operating lever 101 is further turned to the 180° position, the right-and-left operating members 125,125 are both moved leftward, so that the left operating member 125 is kept in an inoperative position and the right operating member 125 is kept in an operating position. Furthermore, when the operating lever 101 is turned to the 270° position, only the left operating member 125 is pressed rightward and right-and-left operating members 125,125 are kept in an operative position.

While the operating lever 101 is turned from the 270° position to the 360° position or the 0° position, the right and left operating members 125,125 move away from each other and are kept in an inoperative position. Thus, when the operating lever 101 is turned 0° position to 270° position, force promotion for returning the backrest 7 becomes larger stepwise, which is the minimum or only force promotion of the central force promoting unit 105 at 0° ; weak or the sum of the promoting force of the central force promoting unit 105 and the promoting force of the left force promoting unit 104 at 90° ; strong or the sum of the urging force of the central force promoting unit 105 and the urging force of the right force promoting

unit 106; and the maximum or the total sum of the promoting force of all the force promoting units 104,105,106.

In the meantime, while the operating lever 101 is turned from the 0° position to the 270° position, the distance between the left and right operating members 125,125 becomes gradually smaller stepwise, and operation resistant force of the operating lever 101 by the compression spring 128 gradually becomes larger stepwise. With one touch the operation resistance force of the operating lever 101 becomes larger allowing for the recognition that the returning force of the backrest is increasing.

As shown in Fig. 14, there is a casing 131 for receiving locking means 130 for locking the backrest 7 at a desired rearward tilting angle on the upper wall 5b of the base 5. In the casing 131, there is a receiving groove 132 which comprises a right larger-width portion 132a and a left smaller-width portion 132b. In the larger-width portion 132a, there are provided two engagement members 133,134 respectively having teeth 133a,134a which are engaged with the teeth 117 of the sector gear 118 at the same pitch angle. The engagement member 133 is put on the engagement member 134 and they are together slidable. The teeth 133a,134a of the upper and lower engagement members 133,134 are formed with difference in phase by half a pitch from each other, so that any one of them is engaged with the teeth 117 of the sector gear 118.

In each of the engagement members 134,135, a rectangular opening 135 is formed, and a U-shaped groove 136 which communicates with the rectangular opening 135 is formed at the lower end of the left side wall. The upper surface of the casing 131

is covered with a cover plate 137. A partition plate 138 is formed downward from the middle of the cover plate 137 and engaged with the right end of the smaller-width portion 132b. The partition plate 138 has a U-shaped groove 139 from the upper end. A rectangular connector 140 is slidably engaged on the partition plate 139 of the smaller-width portion 132b. On the right side wall of the connector 140, upper and lower U-shaped grooves 141,142 are formed symmetrical with each other vertically, and a U-shaped groove 143 is formed on the left side wall.

A pair of rods 14 having flanges 144a,145a respectively is slidably put through the U-shaped grooves 136,136 of the upper and lower engagement members 133,134, the U-shaped groove of the partition plate 138 and the upper and lower U-shaped grooves 141,142 of the connector 140.

Between outer flanges 144a,145a of the upper and lower rods 144,145 and the left end face of the rectangular bore 135 of the upper and lower engagement members 133,134, compression springs 146,146 which surround each of the rods 144,145 are provided and between the left end faces of the upper and lower engagement members 133,134 and the right side face of the partition plate 138, compression springs 147,147 which surround each of the rods 144,145 are provided.

Force exertion of the compression springs 146 may be determined to be approximately equal to or slightly larger than that of the compression spring 147.

In the U-shaped groove 143 of the connector 140, an outer flange 149a of a shaft 149 of a pull-lock/pull-release mechanism 148

is engaged. In the pull-lock/pull-release mechanism 148, the shaft 149 passes through a rectangular case 150 in the narrower portion 132b. The shaft 149 is pulled from a casing 150 leftward and engaged by a known rotary reciprocation engagement mechanism similar to a push-type ball-point pen in the casing 150 in a left-pulled application. Then, the shaft 149 is pulled leftward again, and the engagement of the rotary reciprocation engagement mechanism is released, so that the shaft 149 is moved rightward. Thereafter, whenever the shaft 149 is pulled leftward, the rotary reciprocation engagement mechanism fluctuates between engagement and disengagement. A stroke of the shaft is longer than a distance required for any one of the teeth 133a,134a of the two engagement members 133,134 to engage with the teeth 117 of the sector gear 118.

The left end of the shaft 149 is connected to the end of the wire 50c which projects from the lower end of the cable 50 the upper end of which is connected to the operating lever 69 of the armrest 14, so that the shaft 149 is pulled leftward whenever the operating lever 69 turns upward.

To install the locking means 130 to the base 5, after the engagement members 133,134, the connector 140, the rods 144,145, the compression springs 146,147 and the pull-lock/pull-release mechanism 148 are all inverted and connected to the inverted cover plate 137 in order, they may be inserted in the groove 132 of the casing 131 while inverted together.

As shown in Fig. 19, when the shaft 149 is pulled leftward and locked, the connector 140 is moved leftward by the outer flange 149a

and the upper and lower rods 144,145 are moved leftward. Usually owing to the balance of forces in the compression springs 146,147, the upper and lower engagement members 133,134 stop in an inoperative position where the teeth 133a,134a are disengaged from the teeth 117 of the sector gear 118. In this situation, the backrest 7 is always inclined toward a standing position by promoting force adjusted by the operating lever 101 and can be tilted rearward with a suitable resistant force by pressing it rearward against the promoting force.

In this situation, after the backrest 7 is tilted rearward to a desired angle, the operating lever 69 of the armrest 14 is turned upward and the shaft 149 is moved leftward once to facilitate release of the pull-lock/pull-release mechanism 148. As shown by a solid line in Fig. 20, the shaft 149 is moved rightward, so that the connector 140, the upper and lower rods 144,145 and the upper and lower engagement members 133,134 are moved rightward by the balance of force in the compression springs 146,147 allowing any one of the teeth 133a,134a of the upper and lower engagement members 133,134 to engage with the teeth 117 of the sector gear 118. If such engagement does not occur, the backrest 7 is slightly tilted in a back-and-forth direction thereby allowing any one of the teeth 133a,134a to engage with the teeth 117 of the sector gear 118.

After any one of the teeth 133a, 134a (133a in Fig. 20) is engaged with the teeth 117 of the sector gear 118, the backrest 7 is locked into this position. Even if the back of a sitting person is moved away from the backrest 7, the backrest 7 is never moved from the position to the back-and-forth direction.

When the operating lever 69 is turned upward again from the position where the backrest 7 is locked, the shaft 149 is moved leftward once and the pull-lock/pull-release mechanism 148 is locked, so that the shaft 149 is locked while moved leftward. Thus, any one of the engagement members 133,134 which is disengaged from the upper and lower rods 144,145 and the teeth 117 of the sector gear 118 is moved leftward. In this example, the lower engagement member 134 is moved leftward.

However, the engagement member 133 which is engaged with the teeth 117 of the sector gear 118 receives large exerting force in an approximately right-angled direction not to move away from the sector gear 118 suddenly. Only when the sitting person is resting against the backrest 7 to put load on the engagement members 133,134 against the above force, the engagement members 133,134 are disengaged from the sector gear 118 and moved leftward owing to the balance of forces in the compression springs 146,147. For this purpose, the upper and lower engagement members 133,134 are not joined to the upper and lower rods 144,145 but allowed play by the compression springs 146,147.

As described the above, in this embodiment, forth promotion for returning the backrest 7 can be adjusted stepwise over a wide range by turning the operating lever 101, and the backrest 78 is locked or unlocked at a desired angle by the operating lever 69.

In this embodiment, the backrest and the seat are supported on the base to enable rearward-and-downward inclination together and urged forward-and upward by the force promoting return means, but the present invention may be applied to a .chair in which any one

of a backrest and a seat is supported to enable rearward-and downward inclination.

The force promoting units may be two or more than three, or all promoting forces can be selected and transmitted to a backrest or a seat.

Three or more engagement members 133,134 may be provided, in which phases of the teeth 133a,134a are shifted by 1/3 or one divided by the number of the engagement member to each other, adjustable pitch can be further decreased.

Figs. 21 and 22 show an exit of the cable 50 at the lower end of the armrest 14. At the side end of the armrest mounting rod 17a which extends from the middle of the backrest support rod 12, the L-shaped connecting rod 17 is fastened by allowing a bolt 152 inserted through an opening 151 to mesh with a female bore 153 of the armrest mounting rod 17a.

The cable 50 in the arm post 15 is taken out of an exit 154 of the connecting rod 17 toward the seat 8 and connected to the shaft 149 of the tilting means "A" at the lower end. A recess 155 is formed on the upper surface of the connecting rod 17 to communicate with an exit 154 and has a part of the cable 50 therein. At an inner bending portion of the connecting rod 17, a synthetic cover 156 which can cover the exit 154 and the recess 155 is provided.

The cover 156 is bent to cover a bending portion of the connecting rod 17 and has an inverted U-shape as shown in Fig. 22.

As shown in Fig. 21, an engagement portion 156a is provided at the upper end of the cover 156 and engaged in the exit 154 of the

connecting rod 17. A mounting piece 156b which has a thread bore 157 is formed at the lower end of the cover 156.

To secure the cover 156 to the arm post 15, the engagement portion 156a is engaged in the exit 154 while the cable 50 is taken out of the cover 156. Thereafter, the mounting piece 156b is fixed to the arm post 15 by engaging a lead screw 158 into a thread bore 159 through a screw-insertion bore 157.

The cover 156 over the cable 50 is cosmetically pleasing by allowing the exit 154 to be covered with the cover 156. The lower end of the cable 50 is put in the recess 155 in the cover 156, so that the cable 50 loosened in the arm post 15 is kept stable in the cover 156 without moving in a depth direction when the armrest 14 is adjusted in height.

In this embodiment, the cable 50 is partially covered with the cover 156. However, the cable 50 may be covered over a wider range by expanding the size of the cover. The cover 156 may be mounted at the upper end to the arm post 15 by a screw.

Figs. 23 to 27 show a variation of a connecting portion of an operating lever 69 and a cable 50 in an armrest 14 and a horizontal position adjusting mechanism of an arm pad 16.

A slidable stopper plate 160 is disposed on an armrest base plate 51, and the rear portion of the stopper plate 160 is fixed to a smaller-diameter shaft 54a of a support shaft 54 by a screw 74.

Numeral 161 denotes a position-adjusting plate movable in a depth direction on the armrest base plate 51 in the front of the stopper plate 160, and has a rear end face which has a plurality of engagement grooves (not shown) engagable with the front end of the

stopper plate 160 selectively. The position adjusting plate 161 and the stopper plate 160 constitute horizontal position adjusting means for the arm pad 16.

A concave portion 162 is formed on the lower surface of the front portion of the armrest base plate 51.

Under an auxiliary arm 56d in the front of an arm body 56b of a support arm 56, there is formed a through bore 163 in which an engagement ball 50d at the end of a wire 50c is inserted. Under the auxiliary arm 56d, a slit 164 in which the end of the wire 50c is inserted is formed to communicate with the through bore 163.

To engage with and keep the engagement ball 50d of the wire 50c, an arc-sectioned step 165 is formed on the rear surface of the auxiliary arm 56d of the arm body 56b to partially communicate with the slit 164.

In Figs. 26 and 27, between support portions 69b and 69b of a lever body 69a of the operating lever 69, a semicircle-sectioned wire holder 166 projects from the rear end of the operating lever 69 and has a recess 167 in which the wire 50 is slidably engaged. In front of the wire holder 166, a through bore 168 in which the wire 50c is inserted is formed in the lever body 69a.

To mount the upper end of the cable 50 to the operating lever 69, the wire 50c is allowed to pass through the through bore 168 and to wind in the recess 167 of the wire holder 166 of the operating lever 69. Then, the engagement ball 50d is engaged on the step 165 through the through bore 163 of the support arm 56.

When the operating lever 69 is turned upward while fixing the end of the wire 50c, the wire 50c is pulled twice as long as forward

movement of the wire holder 166 as shown in Fig. 24. The operating lever 69 can be turned until the front end of the lever 69 is engaged on the lower surface of the concave portion 162 of the armrest base plate 51.

The foregoing merely relates to embodiments of the invention. Various changes and modifications may be made by a person skilled in the art without departing from the scope of claims.